

**(19)**  
**(12)**

**(KR)**  
**(A)**

**(51) . Int. Cl.7**  
**H01L 21/3065**

**(11)**  
**(43)**

**10-2004-0066170**  
**2004 07 23**

---

(21)	10-2004-7009233		
(22)	2004 06 14		
	2004 06 14		
(86)	PCT/US2002/039906	(87)	WO 2003/052808
(86)	2002 12 12	(87)	2003 06 26

---

(30)	60/341,135	2001 12 13	(US)
------	------------	------------	------

(71)	95054	,	3050
------	-------	---	------

(72)	, , ,	95135	3071
------	-------	-------	------

, , ,	94086	#710	201
-------	-------	------	-----

, , ,	94040		1751
-------	-------	--	------

, , ,	95023		1300
-------	-------	--	------

, , ,	03848		21
-------	-------	--	----

(74)

---

(54)

---

C<sub>a</sub>F<sub>b</sub> (a/b 2/3)

1 가

C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> (x/z 1/2)  
가

2 가

, ,

CD

, 1 2 가

## (fluorochemical)

(Self-Aligned Contact; SAC) , 2  
 (10) (2) (12) (14) (18)

가	(16)	n	n	p	(16)	가
,	/	,	,	,	,	가

가 (fluorocarbon) 1 SAC , U.S. 6,174,451( Hung ) 1 2 . 1 , C<sub>4</sub>F<sub>6</sub>/Ar  
가 , Hung , 2 , C<sub>4</sub>F<sub>6</sub>/Ar/CH<sub>2</sub>F<sub>2</sub>  
, CH<sub>2</sub>F<sub>2</sub>/O<sub>2</sub>/Ar가 , CH<sub>2</sub>F<sub>2</sub>  
1 2 F/C , 3

U.S. 6,174,451(Hung ) , SAC 0.35 , 0.14 , , Hung 0.25 가

, Hung , , , 0.25 ,



x/z 1/2;

x/y 1/3.

, C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> 가  
 C<sub>a</sub>F<sub>b</sub> , 가  
 2 F<sub>4</sub>) 2 가 C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>  
 F<sub>b</sub> .  
 , C<sub>4</sub>F<sub>6</sub> C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>  
 가 Ar 가 .  
 , C<sub>4</sub>F<sub>6</sub> 1 C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>  
 .

, (a) 1  
 -; (b) C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> 가 2 가 , a/b 2/3 x/z 1/2 C<sub>a</sub>F<sub>b</sub> 가 1 가 ,  
 가 1 RF 가 ; (c) ; (d)  
 .

, (a)  
 ; (b) 가  
 , , 가  
 . 가 C<sub>a</sub>F<sub>b</sub> 1 가 , C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> 2 가 , a/b 2/3  
 x/z 1/2 .

, C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> 2 가 a/b 2/3 x/z 1/2 , C<sub>a</sub>F<sub>b</sub> 가  
 1 가 , ; (b) C<sub>4</sub>F<sub>6</sub>, O<sub>2</sub>, Ar 가  
 4 가 , ; (c) C<sub>4</sub>F<sub>6</sub>, O<sub>2</sub>, Ar, C<sub>2</sub>H<sub>2</sub>F

, (a) 1 ,  
 2 , 4 , 3  
 ; (b) 4 , C<sub>4</sub>F<sub>6</sub>, O<sub>2</sub>, Ar 2 1 가  
 H<sub>2</sub>F<sub>4</sub> Ar 2 가 ; (c) 3  
 .

, / Mean Wafer Between WetClean(MWBWC  
 ) , C<sub>x</sub>H<sub>y</sub>F<sub>z</sub>/C<sub>a</sub>F<sub>b</sub>/O<sub>2</sub> 가  
 C .

, 1 2 SAC 가  
 . 0.25 , 0.18 ,  
 0.14 가 ,  
 , SAC .  
 가 (O<sub>2</sub> Ar 가 ) C<sub>4</sub>F<sub>6</sub>, C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>  
 1 가 C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> 2 가 ,  
 , 가  
 (spectrographic)

1 SAC .  
2  
3 SAC

가 (%) (%) , 가

, ' (selectivity)' 가 a) . , b)

, , , ,  
 $\text{SiN}_x$  , x 1 1.5 (BPSG)  
 $\text{SiO}_x$  . (Si<sub>3</sub>N<sub>4</sub>)

가 , C<sub>a</sub>F<sub>b</sub> 가 1 가 1 ( , C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> ) 가 2 가 2 가 2 ( , ) 가 .

$$a/b = 2/3 ;$$

x/z 1/2 ;

$$x/y = 1/3.$$

, 134 CH<sub>3</sub>F(x/y=1/3), CH<sub>2</sub>F<sub>2</sub>(x/y=1/2), / C<sub>4</sub>F<sub>6</sub> . , C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>(CHF<sub>3</sub>, x/y=1) (C<sub>4</sub>F<sub>8</sub>) . ,

가 , 가 . . . . .  
가 , 가 . . . . .

RF 가 .  $C_a F_b / C_x H_y F_z$   $C_a F_b / O_2$  가 , 가 , 가 , 가 ,

, 가 C<sub>x</sub>H<sub>y</sub>F<sub>z</sub>/C<sub>a</sub>F<sub>b</sub>/O<sub>2</sub> 가 F , , 가 M

, C<sub>x</sub>H<sub>y</sub>F<sub>z</sub> 가 가  
C<sub>a</sub>F<sub>b</sub> 가  
가 C<sub>a</sub>F<sub>b</sub> C<sub>a</sub>F<sub>b</sub>  
(knob) ( 0 ) 가

, C<sub>4</sub>F<sub>6</sub>/O<sub>2</sub>/Ar/C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> SAC C<sub>4</sub>F<sub>6</sub>/O<sub>2</sub>/Ar

IPS 6,238,588 ( (Collins) ) EP-840,365-A2  
6,705,081 6,174,451 (Hung )

U.S. 6,232,236( ) MERIE 가 MERIE

MERIE

(OES:Optical Emission Spectroscopy)  
2

MERIE

MERIE

가

(raw)

500      700      ,      )      가      .  
                ,      )      가      .

SAC

$C_4F_6$  (main) OES

$C_2H_2F_4$  가 (heighten)  $C_4F_6$   $C_2H_2F_4$   $C_2H_2F_4$  가  
,  $C_4F_6$  가

$C_4F_6$  ,  $C_2H_2F_4$  가 (necking) (3000 4000 ) (occlusio  
n) 가 가 , (3000 4000 ) ,  
 $C_2H_2F_4$  가

가 (SAC:self-aligned contact) 3 (202) SAC  
(203), ( ) 가 (204) (205)  
(210) (210)

100 500 (210) (Si<sub>3</sub>N<sub>4</sub>) (212) (215) (21  
4) , (210) , p- n- (216)  
(210) (210)

3 4000 15000 9000 TEOS/PET cos/PSG(207)(  
BPSG/PSG ) (208) 2 가 (filed)  
4000 9000 (220) (208) (222) (212) (215) (214)  
(224) (222) , (post-etch) (212) (215) (214)  
(222) , BARC(Birefringent Antireflective Coating;223)  
900 ,

2 가 가 , 3

(1)

(2) (WSi<sub>x</sub>), , ( );

(3) (WSi<sub>x</sub>) ( ).

가 SAC (challenge) 0.14 0.25μm (222) (210) (222) (210) , SAC  
(registry) 가 , , , , , SAC (212) (21)

2) (212) (214), (226), (226) 가 가

, 가 (curly) , (CMP) 가  
100%,

, (220) (210) (214) (222) 가

1

(134)

eMAX 가 MERIE C<sub>4</sub>F<sub>6</sub> / 9% PSG 134/O<sub>2</sub> /Ar 가 3

: 40 80mTorr

: 1000 1800

: 15 35

B- : 0 50 가

O<sub>2</sub> : 15sccm

: 2-8sccm

: 500sccm

C<sub>4</sub>F<sub>6</sub> : 20-30sccm

60 90

2

(134)

가

DUV PR	
BARC	700
TEOS	4000
BPSG	4000
SiON	180

1		, BPSG	(8)	C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar
	25:15:500			
	, 6:80:90	(134)/CHF <sub>3</sub> /Ar		
	가		(134)	
3				
	C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar			
		2 가 BPSG	C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar	30/20/500 TEOS
	C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar/ (134A)	27/15/500/9		BPSG C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar/ (134)
A)			, 1	
	, C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar			
4				
	(134)/C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar			
		1		
	가 2	C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar/ (134A)		3 27/15/500/4 BPS
A)				
	C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar/ (134A)	(134A)		가 (134)
5				
	(134)/C <sub>4</sub> F <sub>6</sub> /O <sub>2</sub> /Ar			
	F <sub>6</sub> /O <sub>2</sub> /Ar/ (134)	27/15/500/8	가	1
	, 8		(134)	
		, 8	12	(134) 가
	가		(134) C <sub>4</sub> F <sub>6</sub>	,
		, 가		
	가			
		,		
	,	(	)	
		,		/
		/		
	,	(	)	
		,		

(57)

1.

1 가  $C_a F_b$  1 가 , 2 가  $C_x H_y F_z$  가 , a  
 $/b \quad 2/3, x/z \quad 1/2, a, b, x, y \quad z \quad 0$

2.

1 , x/y 1/3

3.

1 , Ar

4.

1 , a 4

5.

1 , x 1 3

6.

1 ,  $1 \times 10^{-11} / \text{cm}^3$

7.

1 ,  $1 \times 10^{-9} / \text{cm}^3 \quad 1 \times 10^{-11} / \text{cm}^3$

8.

1 , , 6:1

9.

1 , , 8:1

10.

1 , , 20:1

11.

1 ,

12.

11 ,

13.

11 , 0.25

14.

11 , 0.18

15. 11 , 0.14

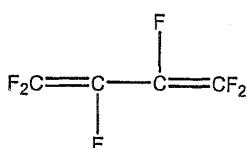
16. 1 , 2 가 C<sub>2</sub>H<sub>2</sub>F<sub>24</sub>

17. 1 , 2 가

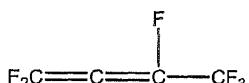
18. 17 , 2 가 1,1,1,2-

19. 1 , 1 가 C<sub>4</sub>F<sub>6</sub>

20. 19 , 1 가



21. 19 , 1가



22. 1 , C<sub>4</sub>F<sub>6</sub>, C<sub>2</sub>H<sub>2</sub>F<sub>4</sub>, O<sub>2</sub> Ar

23. 1 , C<sub>4</sub>F<sub>6</sub>, CH<sub>3</sub>F, O<sub>2</sub> Ar

24. 1 , C<sub>4</sub>F<sub>6</sub>, CH<sub>2</sub>F<sub>2</sub>, O<sub>2</sub> Ar

25. 1 , CO

26. 21 , , C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> O<sub>2</sub>

27. 25 , C<sub>2</sub>H<sub>2</sub>F<sub>4</sub> O<sub>2</sub> 4 6

28. 21 , , C<sub>4</sub>F<sub>6</sub> O<sub>2</sub> 0.5  
1.0

**29.**

1 , 2 가

1 2 , 1 가

**30.**

29 , , 2 1 1 2

**31.**

1 , (magnetically enhanced reactive ion etcher)

**32.**

31 , , 0 40

**33.**

40 80 mTorr

**34.**

1 , 50 가

**35.**

1 , 10 40 가

**36.**

, 1 - 1 ;

가  $\frac{C_x}{z}$   $\frac{H_y}{0}$   $\frac{F_z}{;}$  2 가 , , 가  $\frac{C_a}{a/b}$   $\frac{F_b}{2/3}$   $\frac{x/z}{1/2}$  1 , a, b, x, y

RF

1

**37.**

36 , ;

1

1

**38.**

36 , 1

**39.**

36 , 1

**40.**

36 , ,

**41.**40 , 가 1 , -40  
20**42.**40 , 가 1 , 0  
20**43.**

36 , DC

**44.**

36 , 가

**45.**

, ;

가

가  
 $a F_b$  1/2,  $x/z$  2/3,  $a, b, x, y$  ,  $1 가 z$ ,  $C_x H_y F_z$  0  
 $a/b$   $2/3, x/z$  1/2가  
2 가 , , 가

C

**46.**

;

2 가 , , 가  
 $C_a F_b$  1/2,  $x/z$  2/3,  $a, b, x, y$  ,  $1 가 z$ ,  $C_x H_y F_z$  0  
 $a/b$   $2/3, x/z$  1/2**47.**

46 , 가

**48.**46 , 2 가  $C_2 H_2 F_4$ **49.**

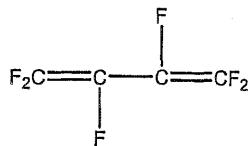
46 , 2 가

**50.**

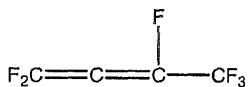
46 , 2 가 1,1,1,2-

**51.**46 , 1 가  $C_4 F_6$ **52.**

46 , 1 가

**53.**

46 , 1가

**54.**46 ,  $\text{C}_4\text{F}_6, \text{C}_2\text{H}_2\text{F}_4, \text{O}_2$  Ar**55.**46 ,  $\text{C}_4\text{F}_6, \text{CH}_3\text{F}, \text{O}_2$  Ar**56.**46 ,  $\text{C}_4\text{F}_6, \text{CH}_2\text{F}_2, \text{O}_2$  Ar**57.**

46 , CO

**58.**54 ,  $\text{C}_2\text{H}_2\text{F}_4$   $\text{O}_2$  2 8**59.**25 ,  $\text{C}_2\text{H}_2\text{F}_4$   $\text{O}_2$  4 6**60.**21 ,  $\text{C}_4\text{F}_6$   $\text{O}_2$  0.5 1.0**61.**

1 , 2 가 1 2 1 2 , 1 가

**62.**46 , 2  $\text{C}_2\text{H}_2\text{F}_4$  1, 2, 3, 4 3  $\text{O}_2$  1, 4  $\text{C}_4\text{F}$   
6 Ar**63.**

62 , 1, 2, 3, 4 가

**64.**

46 ,

**65.**

64 , 1 2 1 2 , 가

66.

$$64 \quad , \quad 1 \quad C_4F_6 \quad , \quad 2 \quad C_2H_2F_4 \quad , \quad 2$$

$b \quad , \quad m,n > 0 \quad , \quad b < n \quad r < m \quad , \quad b = n \quad r = n$

67.

$C_4F_6O_2$  Ar 가

$\text{C}_4\text{F}_6$ ,  $\text{O}_2$ , Ar     $\text{C}_2\text{H}_2\text{F}_4$

68

1 (a).

2 (b)

$$C_4F_6, O_2 \quad Ar \quad 1\text{ 가}.$$

1

$$\text{C}_4\text{F}_6, \text{O}_2, \text{C}_2\text{H}_2\text{F}_4 \quad \text{Ar}$$

가

69.

68 . . . 1 (phosphorosilicate)

70

68 . . . . . 2 (tetraethylorthosilicate)

71

68 1 2 가

72

68 2 1 칸

73

68 70. 3

74

68 2 1

75

1 2 - 1 2 0.25

76.

75

77.

75

78.

75

79.

78

80.

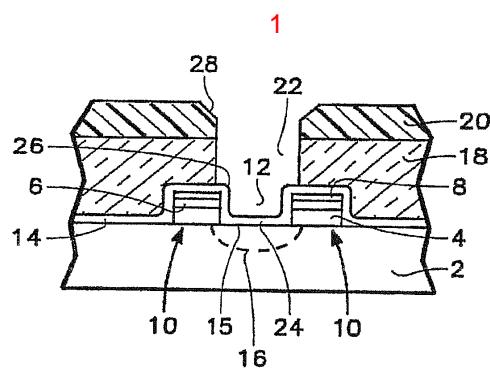
78

1

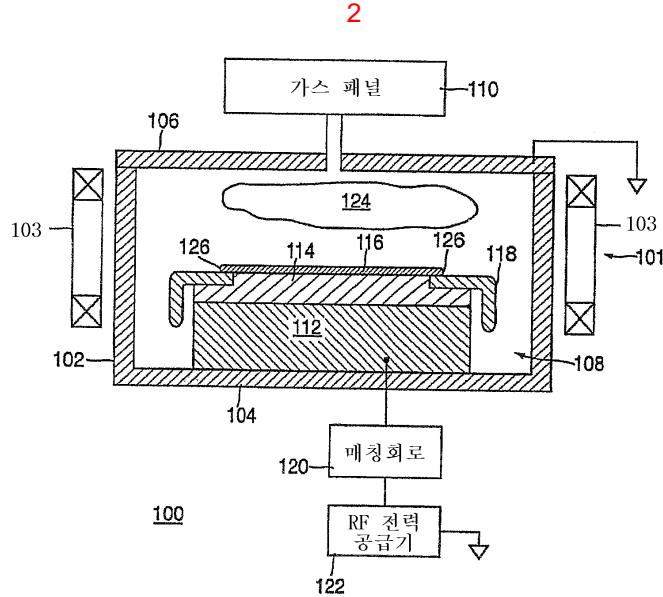
2

2

1



1



2

